



HOUSE PAINTS



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HOUSE PAINTS

THESE pages present to the paint manufacturers of the United States the epitomized results of a study involving nearly forty thousand panels, hundreds of houses, and all the raw materials used in house paints during recent times. This study has been carried out by research groups in the Krebs Pigment & Color Corporation over the past ten years and in three strategic locations: Hialeah, Florida; Wilmington, Delaware; Amarillo, Texas.

Object of the Study:

Though this program of necessity involved comparisons of vehicles, prime pigments, extenders, driers, pigment concentrations, methods of application, types of wood, etc., the object was, relatively, a direct and simple one: How do these various pigments compare with one another in their general behavior and durability? And, having this information, what pigment combinations give the most durable and the best appearing paints.

We can only mention briefly, because of space limitation, the enormous mass of detailed testing required in order to assure the soundness of each conclusive step — a ten-year study of forty thousand panels. These paragraphs present, therefore, merely the end-points of the investigation with the final conclusive evidence bearing upon them. We limit this report to one general vehicle, one type and amount of drier, one pigment volume, uniform consistency, and one method of application.

The Test Panels — Their Preparation

MATERIAL: Selected Edge Grain White Pine (except as noted hereinafter)

NON-TEST FACES: Edges and backs protected by heavy white coating.

PAINT SYSTEM: *First Coat:* Test paint plus one pint linseed oil per gallon. Dried two days before second coat applied.
(self primed)

Second Coat: Test paint plus one-half pint linseed oil per gallon.
Dried three days before third coat applied.

Third Coat: Test paint unthinned.

The panels were placed on fences immediately after drying of third coat.

The Test Panels — Position of Exposure

This general study, as well as others, has indicated that reliable data are obtained only from prolonged and repeated vertical Southern exposures, followed by house tests and supplemented by Northern vertical exposures to acquire information on dirt collection, mildew, and variation in appearance. Exposures at 45° South have limited value in drawing reliable conclusions and such results, as obtained, must be considered judiciously. Preliminary helpful information may be had from 45° South exposures, but, too, the acceleration of changes and failures may be misleading.

The Test Panels — Location of Exposure — Climate

Hialeah, Florida. This location provides conditions of high humidity, fairly high temperatures, slight temperature and humidity variation during any one day. Exposures here produce accelerated results, still more so at 45° South, particularly in chalking, fading, mildew growth and dirt collection. When not judged for this locality itself, results here are used for preliminary aids to avoid formulas weak in the respects just mentioned.

Florida and similar climates cause more rapid chalking and erosion with reduced tendencies toward cracking and checking than in the average (Delaware) climate. Paints for Florida, therefore, should be slightly harder than those used generally throughout the country.

Amarillo, Texas. In addition to providing general data on the effect of very high temperatures, low humidities and severe and rapid temperature changes, this location develops accelerated effects of cracking and checking. These behaviors are further accelerated by using yellow pine panels and the 45° South position.

Climates of this sort require paints softer and more flexible than needed in other less rigorous localities.

Near Wilmington, Delaware. This locality has a climate as found in a large portion of the United States, particularly the area East of the Mississippi-Missouri river system. There are no accentuated effects in this location. Consequently, most of the more extensive tests have been conducted in this area and in nearby Maryland and Pennsylvania. 45° South, North Vertical, South Vertical, houses, barns and garages have all been used.

House Tests

Naturally, certain combinations of material have displayed more promising results than others in repeated panel tests and these more promising paints have been subjected to additional tests by actually painting houses with them. These houses, situated in various parts of the United States, have been carefully selected and prepared for these tests. Whenever possible, the previous painting history of these houses has been ascertained. If the earlier paint was in suitable condition, the test paint was applied over it. If the house was not suitable for repainting because of bad paint failure, severe moisture conditions or for other reasons susceptible of correction, the proper preliminary steps were taken including removal of old paint, elimination of leaks, special treatment of sappy wood, etc., before application of the test paint. In the case of each house painted, several control paints were applied so that relative paint failures could be observed under similar conditions of application and exposure.

The painting of test houses has in each case been carefully controlled to assure that the test paints were applied for each coat strictly in accordance with the above mentioned reductions. Great care was also exercised to assure that the control paints were applied with equal care and with strict avoidance of any contamination of one paint with another. When commercial paints were used as controls, they were reduced according to the manufacturer's instruction.

Panel and House Inspection

The exposures, whether panels or houses, have been periodically inspected over the years, as far as possible using the same observers. Chalking, checking (visual and microscopic) cracking, flaking, erosion, dirt collection, mildew growth, screen staining and general appearance were systematically and progressively noted.

Reasonable Caution and Care in Drawing Conclusions

The variations in climatic conditions from year to year in any locality are sufficient to change somewhat the durability of any particular paint and it has, therefore, been found prudent to repeat tests in any given exposure area before drawing final conclusions. Further, there are likely to be differences between panel exposures and house tests, to say nothing of the differences which develop between 45° and vertical panels, although the South vertical panels usually give results in close agreement with house tests. Repeated tests on numerous panels are also necessary to differentiate between wood failures and paint failures.

Modern Pigment Combinations — A Critical Comment

Tradition, custom and, also, inertia have preserved such place for white lead-in-oil paints, that the accumulated data of years form a familiar basis of comparison with other types of paints which have been developed by paint manufacturers. This refers, of course, only to those exterior paints which have white pigments as their principal constituents among the solid particles. Lead-Zinc paints, lithopone paints, and finally titanium paints, all have their places in the progression of appearance and durability. The following table summarizes this development.

Type of Pigmentation

Lead — Zinc

Less dirt collection, improved mildew resistance, and better tint retention than white lead-in-oil. Very close limitations in formulation to avoid tendency to cracking and flaking failures, with poor repaint surface.

Lithopone — Leaded Zinc

More opaque, whiter, cleaner than lead-zinc; as durable as lead-in-oil; as tint retentive as lead-zinc. Good all-purpose type. Subject to screen-staining.

Titanium—leaded zinc—Extender. (for whites only)

Most opaque; whitest, cleanest, most durable.

Titanium—leaded zinc—Extender. (Newer types for tints or for general use)

More opaque, more tint-retentive and more durable than lithopone paints.

White Paints

When used in the proper proportions with other indicated pigments titanium dioxide produces the whitest, cleanest, and most durable of white house paints. The present state of knowledge and experience is that the best pigments to use are titanium

dioxide, 35% leaded zinc oxide, and magnesium silicate. Much latitude is permissible in the percentage distribution of these constituents, which is fortunate considering the exigencies of climate.

("RAYSIL" mentioned in these pages is an extended titanium pigment of approximate composition: 30% Titanium Dioxide, 70% Magnesium Silicate, intimately blended and treated to give easy working properties in paint making and exceptional results in paint application.)

The Selection and Proportions of Pigments

Exterior house paints with highly desirable characteristics can be made with the "RAYSIL" content ranging between 35% and 50% of the total pigment. The amount of "RAYSIL" used will depend to some extent on the hiding power desired. A second ingredient of these "RAYSIL" exterior paints should be cofumed 35% leaded zinc oxide. The leaded zinc oxide content should range between 40% and 50% of the total pigment, to provide sufficient resistance to chalking and to inhibit mildew. The balance of the pigmentation for best results should consist of selected extenders, particularly of the magnesium silicate type. The third component can be basic carbonate white lead, instead of extender, but it should be recognized that the substitution of white lead for extender will be accompanied by a slight but noticeable impairment of paint durability in the form of slender cracking at about three years. Good repaint surfaces remain, however.

The Importance of Pigment Volume

The paint manufacturer does not roam far afield in the matter of pigment volume. Much study has been given this value in the past and it is established and recognized if the pigment volume is increased significantly, the paints show a greater tendency to chalk, with resultant shorter life. Too low pigment volumes may lead to an "alligator" type of cracking. As a compromise, then, 28.5% pigment volume is regarded as a reasonable standard for commercial exterior paints.

In the matter of consistency there is naturally variation with composition but for good application properties the range is not great. At 28.5% pigment volume (1 volume of pigment to 2.5 volumes of non-volatile vehicle) the consistency of the usual formula is satisfactory and normal. In some cases no thinner will be required while others might take as much as 15% of the total paint volume.

The Vehicle

It has been mentioned previously that one of the factors held constant in this study of exterior paints is the vehicle, 92% alkali refined linseed oil, and 8% kettle bodied linseed oil, body "Q". With this binder there was incorporated the required amount of high lead-low manganese linoleate type of drier and sufficient mineral spirits to yield satisfactory consistency for application.

It is recognized that acid refined linseed oil is used to a considerable extent, but its use should be surrounded by sufficient precautions to assure a fairly low and constant acid number, to secure uniform consistency, and to avoid the possibility of granulation on aging. These precautions are particularly important if reactive materials are present in the pigmentation because of the danger of the formation of metallic soaps with excessive free fatty acids. The same comments may well be applied to the use of raw oil.

Suggested Formulas — White Paints

The following formula for white house paint is based upon the principles set forth above. It produces a paint which, by test, meets exacting commercial requirements for easy manufacture, good application, whiteness, cleanliness, mildew resistance, durability and good repaint surface.

	1 Gallon	100 Gallons
"RAYSIL"	3.08#	308#
Cofumed 35% Leaded Zinc Oxide	3.70	370
Magnesium Silicate	1.47	147
Alkali Refined Linseed Oil	4.43	52.7 gals.
Kettle Bodied Linseed Oil (Body "Q") .....	.38	4.8 "
Drier "P" (See p. 25) .....	.25	2.8 "
Mineral Spirits .....	.61	9.4 "
	13.92#	

In this formula the pigment proportions are:

"RAYSIL"	37.3%
Cofumed 35% Leaded ZnO	45.0%
Magnesium Silicate	17.7%

Under normal conditions of exposure this paint gives excellent durability and a clean white appearance throughout its life. Ultimate failure is by slow chalking, and its resistance to checking and cracking is remarkable leaving an excellent surface for repainting.

The accompanying illustrations (Plates #1 and #3) show the results of exposure tests on this paint against formulations involving the following pigments used in proportions found in extant formulas: "RAYBAR" (30% TiO₂; 70% Barium sulphate); Zinc sulphide; magnesium silicate; B.C. white lead-zinc oxide; B.C. White Lead. The titanium-bearing paints appear exceptionally white and clean, while the others are marred by dirt collection, not having the self-cleaning properties of a titanium paint. The superior film integrity of the titanium paints is noteworthy.

Two modifications of the above "RAYSIL" paint have found considerable use. They are as follows:

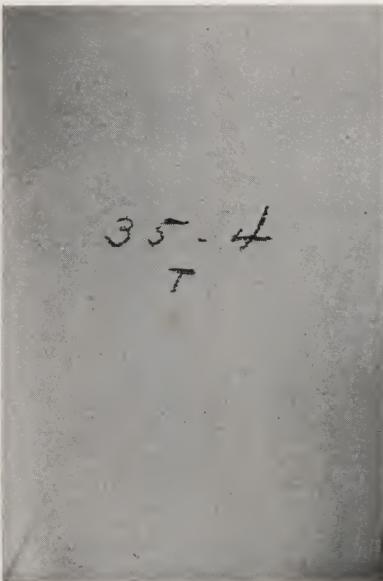
First Modification. A revision of the pigmentation toward a 50/50 — "RAYSIL" cofumed 35% leaded zinc oxide combination to achieve greater hiding power can be made without any sacrifice in either durability or appearance.

Second Modification. The magnesium silicate extender can be replaced by white lead to achieve a pigment combination of:

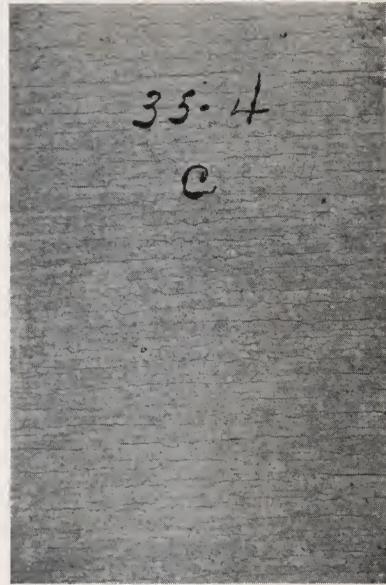
"RAYSIL"	32.5%
Cofumed 35% Leaded ZnO	45.0%
Basic Carbonate White lead	22.5%,

for the purposes of increasing the gallon weight, and of having lead present to satisfy some trade requirements in this direction. Such substitution of white lead for extender causes a noticeable decrease in durability, but gives a slight improvement in brushability as compensation.

PLATE No. 1
House Test
Avondale, Pa.
33 months
South Vertical



35-4
T



35-4
C

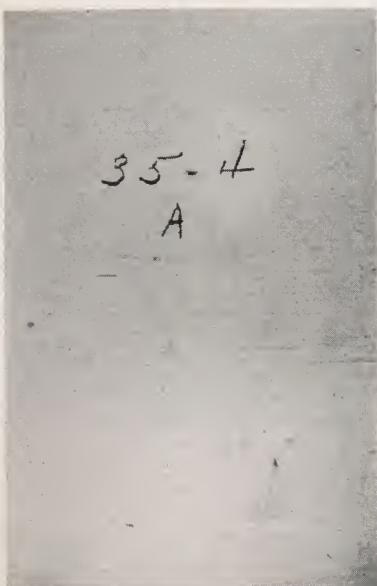
"T"

37.3% "RAYSIL"
45.0% Cofumed 35%
Leaded ZnO
17.7% Magnesium Silicate



"C"

100% B.C. White Lead in Oil



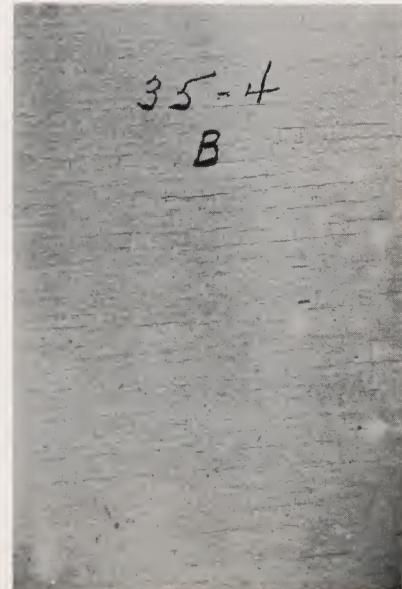
35-4
A

30% "RAYBAR"
30% B.C.W.L.
30% ZnO
10% Magnesium Silicate

"A"

60% B.C.W.L.
30% ZnO
10% Magnesium Silicate

"B"



35-4
B

PLATE No. 3
Garage Door Test
Wilmington, Delaware
12 months
South Vertical



60% Zinc Sulphide Magnesium Pigment
30% Cofumed 35% Leaded ZnO
10% Magnesium Silicate

37.3% "RAYSIL"
45.0% Cofumed 35% Leaded ZnO
17.7% Magnesium Silicate

These two modifications are detailed in the following formulas:

	<i>First</i>	<i>Second</i>
"RAYSIL"	4.25#	3.14#
Cofumed 35% Leaded Zinc Oxide	4.25	4.37
Basic Carbonate White Lead	—	2.19
Alkali Refined Linseed Oil	4.32	4.26
Kettle Bodied Linseed Oil (Body "Q") .....	.38	.37
Drier "P" (See p. 25) .....	.25	.24
Mineral Spirits .....	.75	.81
Total weight in pounds per gallon	14.20#	15.38#

"RAYBAR", titanium barium pigment or "RAYCAL", titanium calcium pigment may be substituted for "RAYSIL" on an equal TiO₂ — equal volume basis in any of the formulas given above, with slight but noticeable sacrifice in durability. Conversely, replacement of a titanium barium pigment, or a titanium calcium pigment, by "RAYSIL" in an exterior paint produces an improvement in durability.

Plates #4 and #5 are offered in support of this principle.

It is generally true that the poorer the durability yielded by the original formula, the greater will be the durability improvement obtained by the substitution of "RAYSIL." This is very evident from the comparison in Plate #6.

Suggested Formulas — Tinted Paints

The familiar lead and lead-zinc paints have still to face the serious charge of dirt collection when they are used as bases for tinted paints. Then, too, the failure by cracking, checking and flaking is still *imminent* though slightly lessened. It is not untoward then, that other types of tinted formulations are sought.

Lithopone formulas have been successful in this field; and recently, novel types of titanium dioxide have been offered commercially which have brought about a new technology in tinted house paint composition.

"RAYTINT", produced in three colors — light gray, dark gray, and light buff — is substantially pure TiO₂ having the coloration distributed evenly and thoroughly through each individual particle. It has excellent chalk resistance.

"RAYOX" O, essentially pure TiO₂, processed to produce chalk resistance, is a white pigment with a slight yellow undertone; suggested use is in tints though it may be adequately white to satisfy some white formula requirements. More chalk resistant than "RAYTINT".

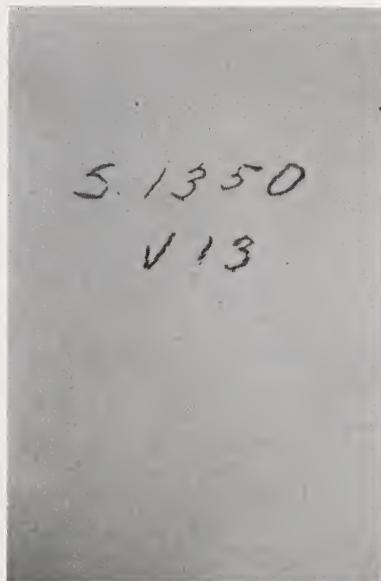
These forms of TiO₂ have exterior wearing qualities which equal, at least, the excellent durability of regular forms of "RAYOX" in white house paints.

Suggested Formulas — Lithopone Paints

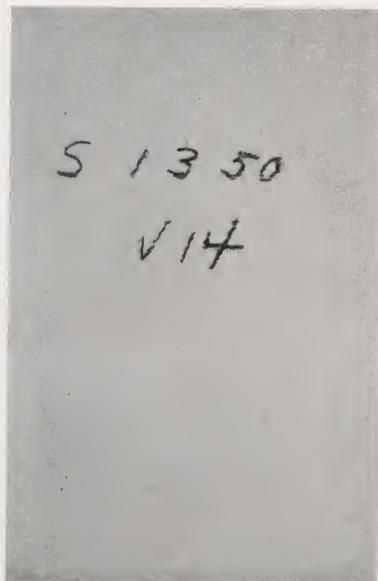
Compromise exterior paints, i.e., house paints intended for use either as whites or tints, are frequently in demand. The use of such compromise formulas involves the necessity of sacrificing some of the superior durability characteristics of paints intended solely for whites or exclusively for tints and accepting also some decrease in tint retention, as compared with formulas intended for tinted paints exclusively. A

PLATE No. 4

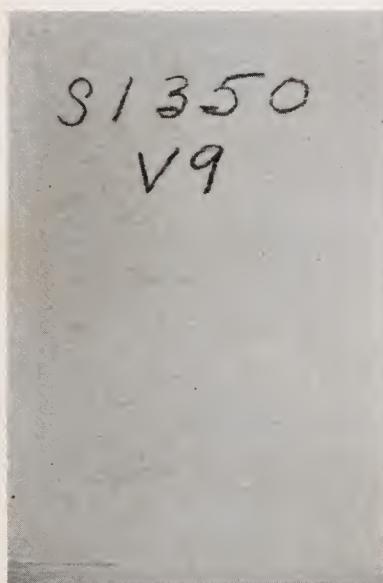
Delaware
41 months
South Vertical



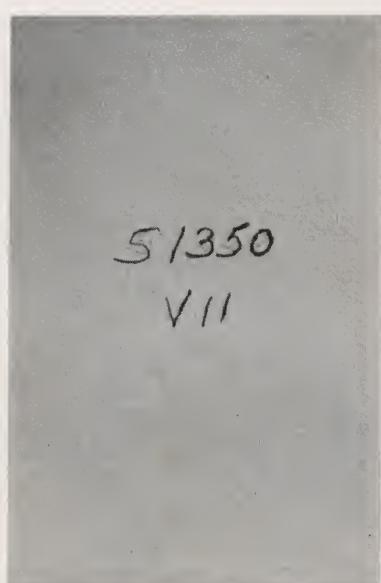
40% "RAYBAR"
40% Confumed 35% Leaded ZnO
20% Magnesium Silicate



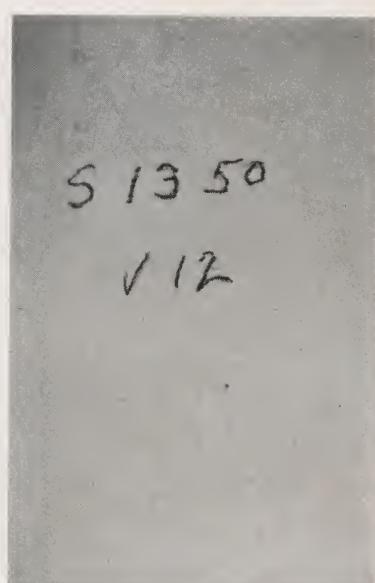
"RAYSIL" replacing "RAYBAR"
in S1350-13



60% BCWL
30% ZnO
10% Magnesium Silicate



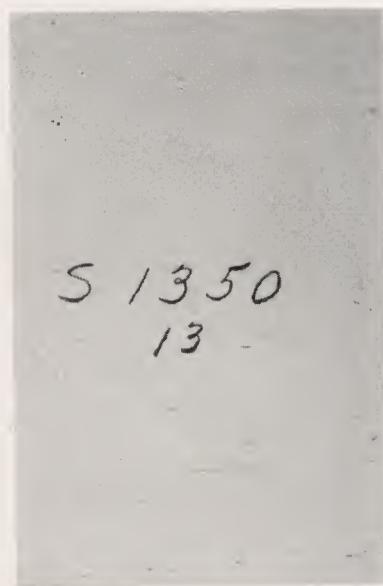
40% "RAYBAR"
42% Confumed 35% Leaded ZnO
18% BCWL



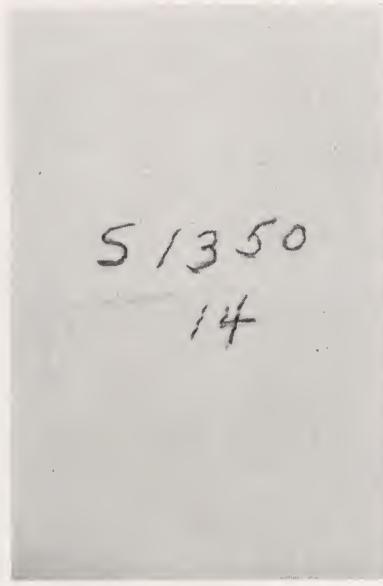
"RAYSIL" replacing "RAYBAR"
in S1350-11

PLATE NO. 5

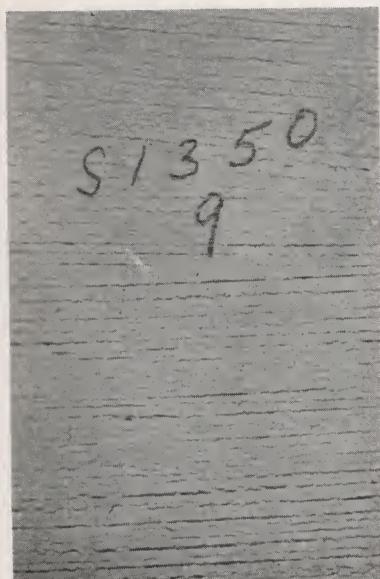
Delaware
41 months
45° South



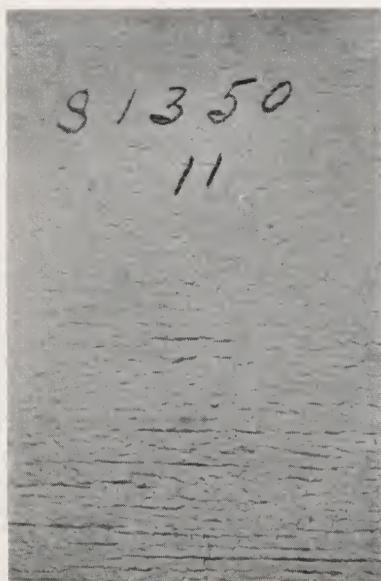
40% "RAYBAR"
40% Cofumed 35% Leaded ZnO
20% Magnesium Silicate



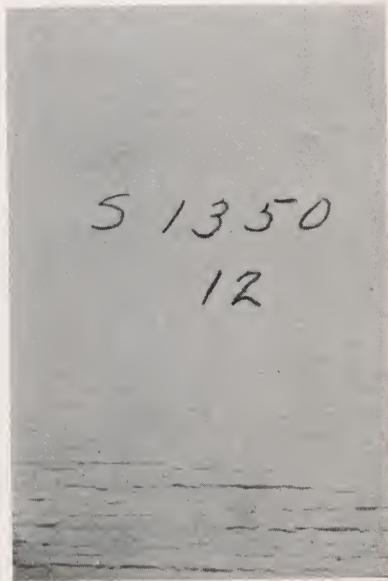
"RAYSIL" replacing "RAYBAR"
in S1350-13



60% BCWL
30% ZnO
10% Magnesium Silicate



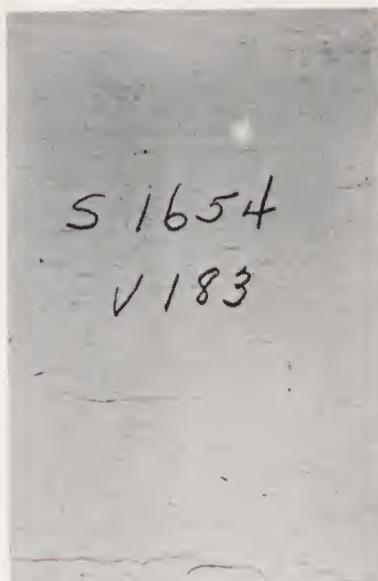
40% "RAYBAR"
42% Cofumed 35% Leaded ZnO
18% BCWL



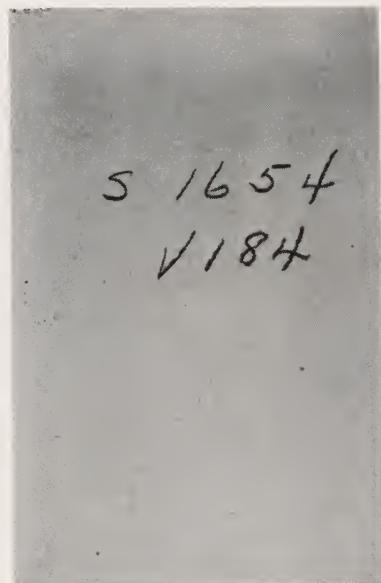
"RAYSIL" replacing "RAYBAR"
in S1350-11

PLATE NO. 6

Delaware
41 months

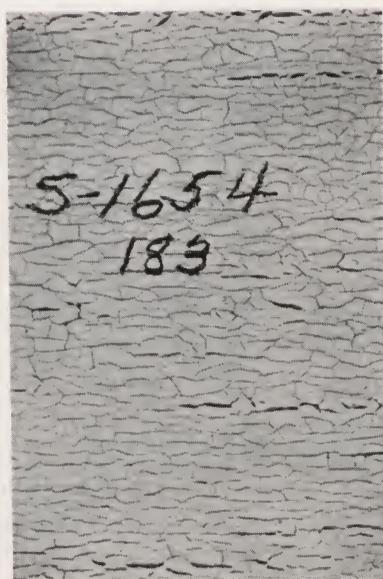


South
Vertical

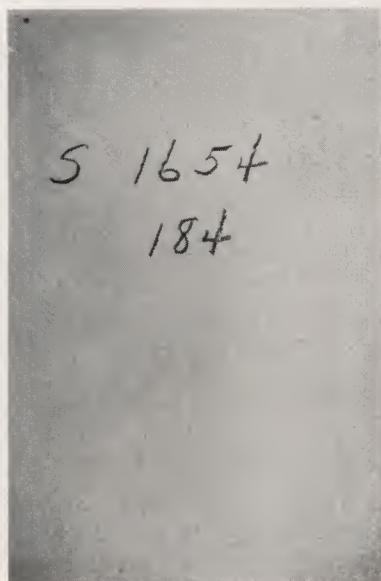


A commercial titanium barium pigment outside house paint

"RAYSIL" replacing titanium barium pigment in S1654-183



45°
South



compromise paint of this type, which shows, perhaps, a minimum loss in desirable paint characteristics, is one which is generally designated as Modified Formula K. It is a lithopone type exterior paint, in which the pigment combination is:

Lithopone	45%
Cofumed 35% leaded zinc oxide	40%
Magnesium silicate	15%

The complete formula for this paint is as follows:

	1 Gallon	100 Gallons
Lithopone	4.09#	409#
Cofumed 35% Leaded Zinc Oxide	3.64	364
Magnesium Silicate	1.36	136
Alkali Refined Linseed Oil.....	4.20	54.2 gals.
Kettle Bodied Linseed Oil (Body "Q") .....	.37	4.7 "
Drier "P" (See p. 25).....	.24	2.7 "
Mineral Spirits .....	.90	13.8 "
Total	14.80#	

Modified Formula K is a revision of the well-known and widely accepted Formula K, produced by increasing slightly the lithopone content and decreasing the leaded zinc oxide. The original Formula K carried a pigment combination:

Lithopone	40%
Cofumed 35% leaded zinc oxide	45%
Magnesium silicate	15%

This revision of Formula K produces a paint with a slightly greater chalking tendency, but with improved durability and little, if any, loss of tint retention.

Plate #7 shows the comparative durabilities, in the untinted white bases, of Modified Formula K and a typical Lead Zinc tint base formula.

Plate #8 makes a similar comparison in a gray paint, bearing especially upon tint retention.

Suggested Formulas — "RAYTINT" Paints

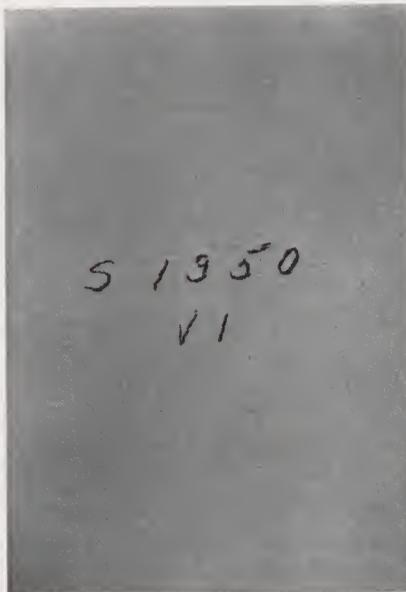
A "RAYTINT" formulation is one way of obtaining in a paint the excellent durability and good repaint surface characteristic of titanium paints without the poor tint retention usually associated with a titanium formula.

RAYTINT paints chalk but at greatly reduced rate. The self-cleaning property of titanium paints is retained though the chalk interferes only slightly with the tint for two reasons: (1) there is so little of it, (2) the chalk itself is colored. These "RAYTINT" paints may be tinted to darker shades without loss of tint retention, but if lightened by the addition of white TiO_2 , fade resistance is proportionately lessened.

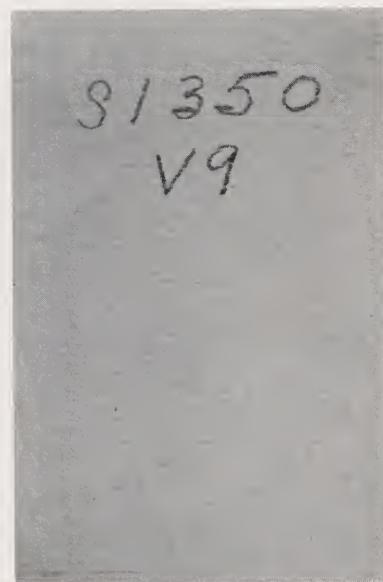
Much latitude is allowed the formulator in preparing "RAYTINT" paints. The amount of "RAYTINT" used, and consequently the supplementary amount of extender, may vary over wide limits without affecting much the resultant durability. There is much freedom therefore in meeting cost requirements. There are two restrictions for

PLATE No. 7
Durability of Modified Formula K
vs. Lead-Zinc

Delaware
41 months

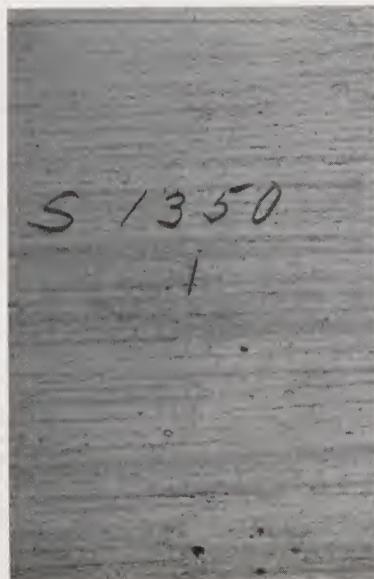


South
Vertical
↔



45% Lithopone
40% Cofumed 35% Leaded ZnO
15% Magnesium Silicate

60% BCWL
30% ZnO
10% Magnesium Silicate



45°
South
↔

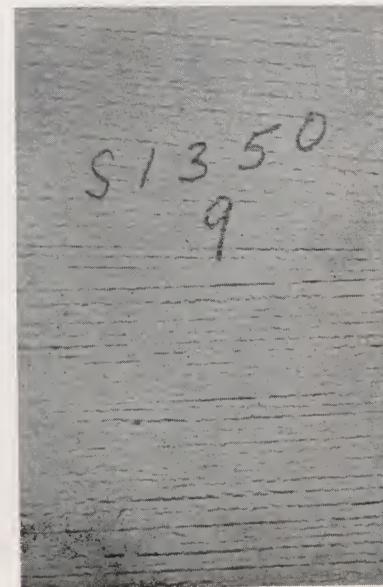


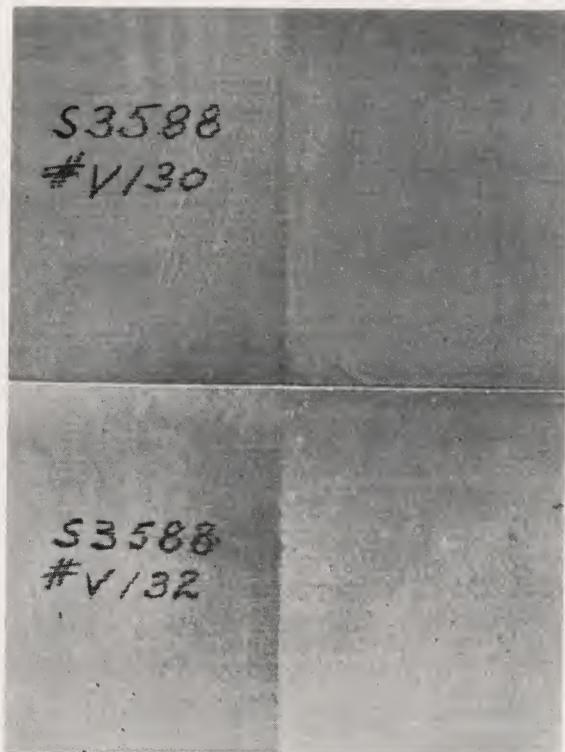
PLATE No. 8
Tint Retention of Modified Formula K
vs. Lead-Zinc
Delaware
8 months
South Vertical

“V130”
45% Lithopone
40% Cofumed 35% Leaded ZnO
15% Magnesium Silicate

“V132”
50% BCWL
35% ZnO
15% Magnesium Silicate

Washed

Unwashed



best results:—retain the pigment volume at the accepted 28.5% — and hold the cofumed 35% leaded zinc oxide content around 40-45%. In localities free of mildew growths the leaded zinc content may be reduced.

This formula is suggested as one of high opacity, excellent color retention and unusual durability.

	<i>1 Gallon</i>	<i>100 Gallons</i>
"RAYTINT"	1.51#	151#
Cofumed 35% Leaded Zinc Oxide	3.52	352
Magnesium Silicate	3.22	322
Raw Linseed Oil	4.36	56.4 gals
Kettle Bodied Linseed Oil (Body "Q") .....	.38	4.8 "
Drier "P" (See p. 25) .....	.25	2.8 "
Mineral Spirits .....	.68	10.4 "
Total	13.92#	

The pigment composition in this formula is

"RAYTINT"	18.3%
Cofumed 35% Leaded Zinc	42.7%
Magnesium Silicate	39.0%

Plates #9, #10, #11, #12 give good comparative pictures of "RAYTINT" formulations and others extending over quite wide range of composition.

The Use of "RAYOX" O in Preparing Tint Bases

The same general scheme set forth for handling "RAYTINT" is followed for "RAYOX" O, that form of pure titanium dioxide in which chalking behavior has been minimized. The pigment volume, as customary, should be kept close to 28.5% and to protect the film completely against mildew growth the leaded zinc content should be 40-45%. Otherwise the freedom in composition is quite wide. Successful applications with excellent exposure history have been made where the "RAYOX" O content was 10% and again where it was 25%, the inert extender varying accordingly.

While "RAYOX" O is primarily a foundation for tint bases it has been considered sufficiently bright in some cases to serve as the basis of a white paint.

Plate #13 illustrates the degree of difference discussed here.

The definite advantages of "RAYOX" O in tinted house paints are: Low cost; excellent durability; tint retention of extraordinary degree; uniform and clean appearance (See Plates #14 and #15.)

Since wide ranges of composition may be practised in "RAYOX" O formulation two suggestions are given below:

<i>Pigment Composition</i>	<i>For Normal Hiding</i>	<i>For High Hiding</i>
"RAYOX" O	12%	18.3%
Cofumed 35% Leaded Zinc Oxide	44%	42.7%
Magnesium Silicate	44%	39.0%

PLATE No. 9
Tint Retention and Durability
of "RAYTINT" Paint

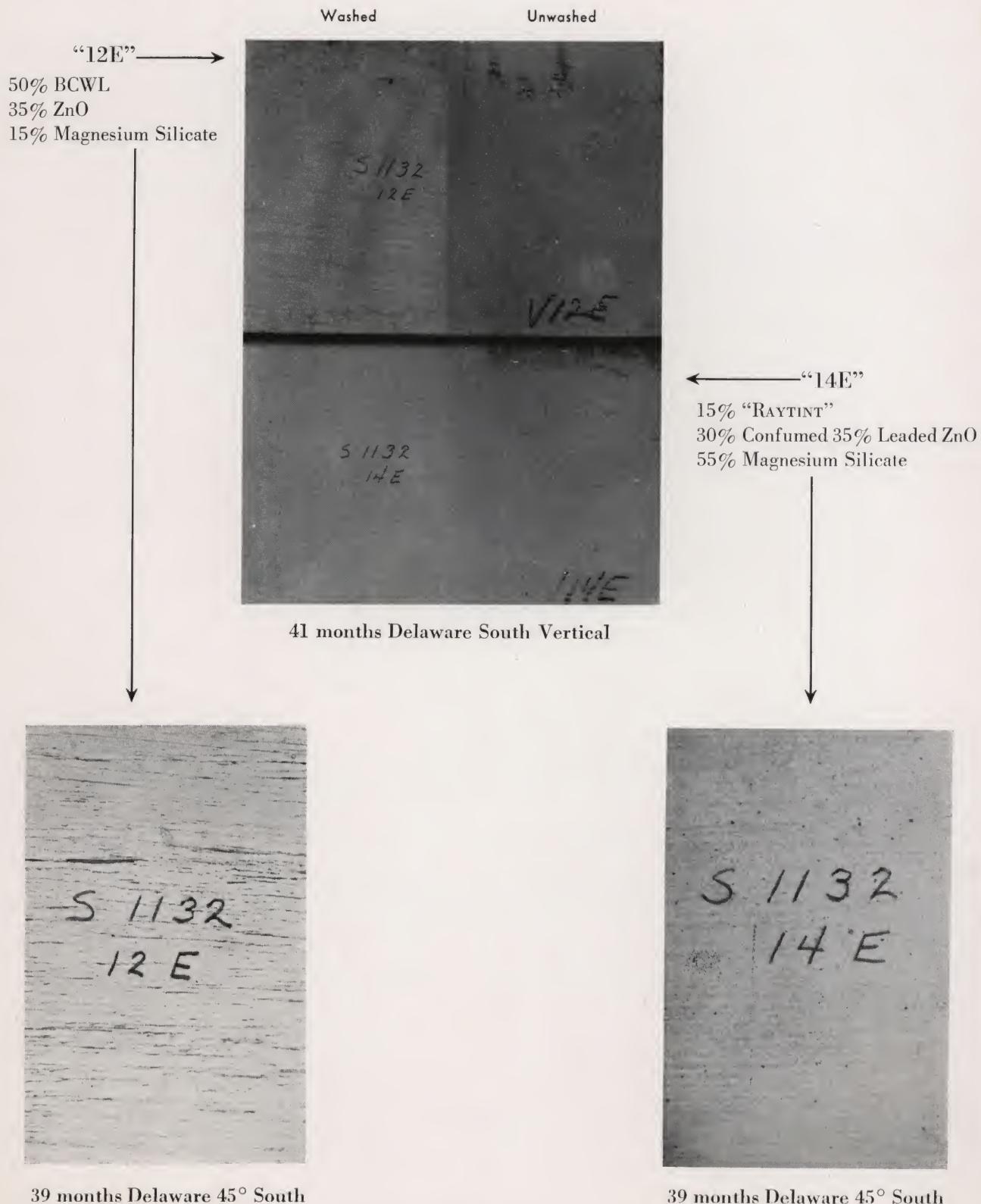
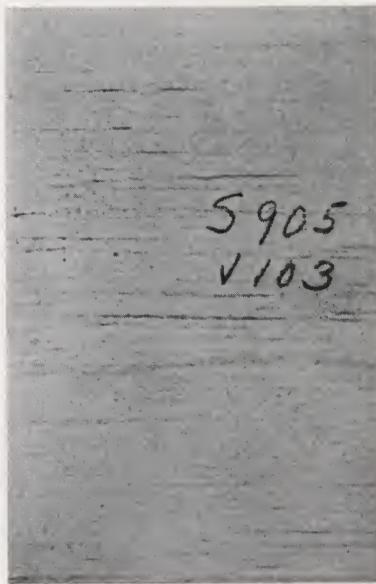
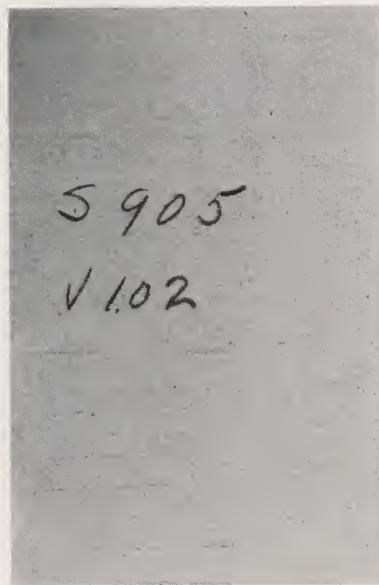


PLATE No. 10
The Reduced Chalking Rate of "RAYTINT"
compared to Normal TiO₂

Delaware
56 months
South Vertical



20% TiO₂
40% Cofumed 35% Leaded ZnO
40% Magnesium Silicate



"RAYTINT" replacing TiO₂
in S905-103

PLATE No. 11
House Test
Wilmington, Delaware
48 months
South Vertical

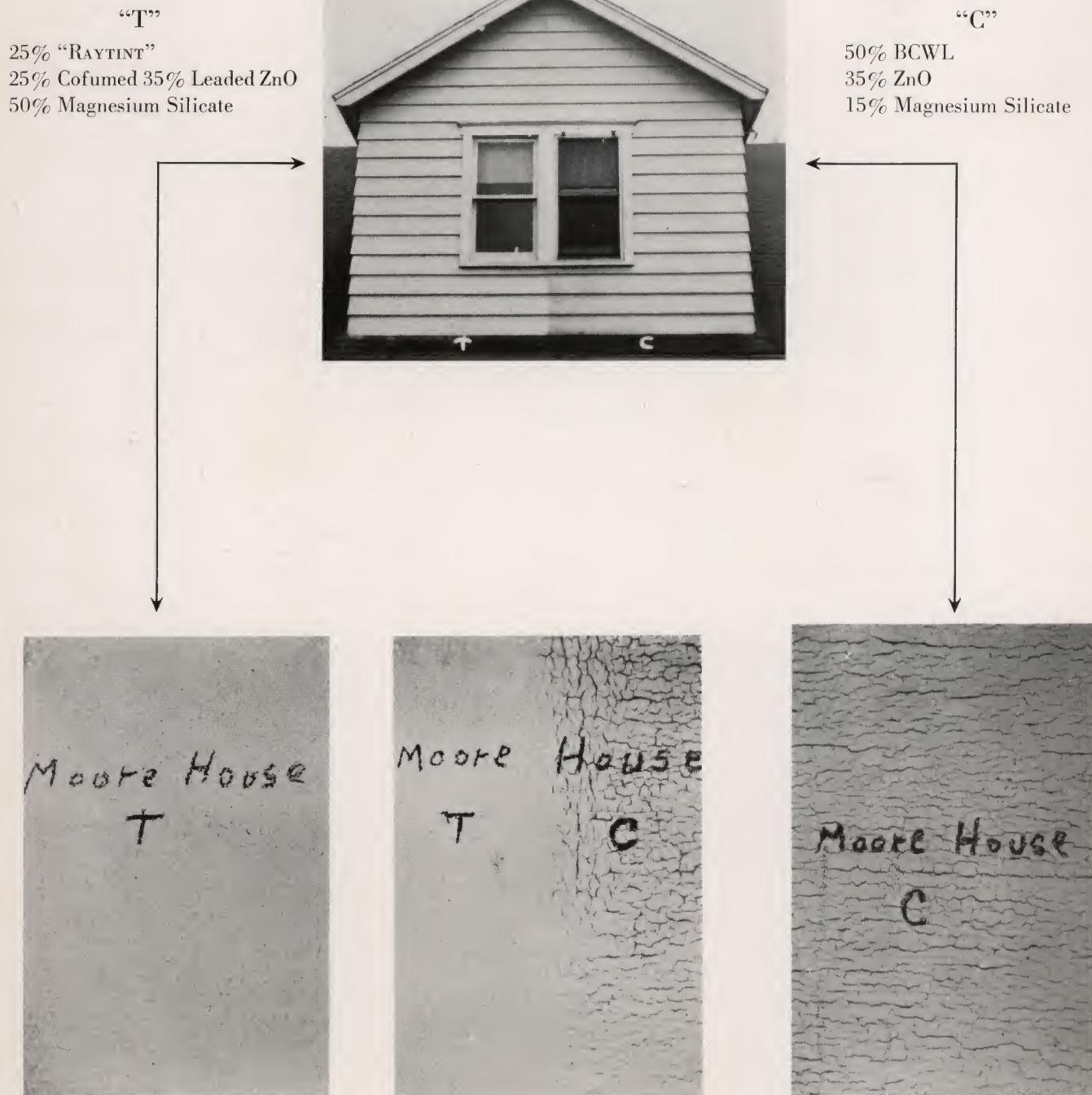


PLATE No. 12
Garage Test
Wilmington, Delaware
48 months
South Vertical

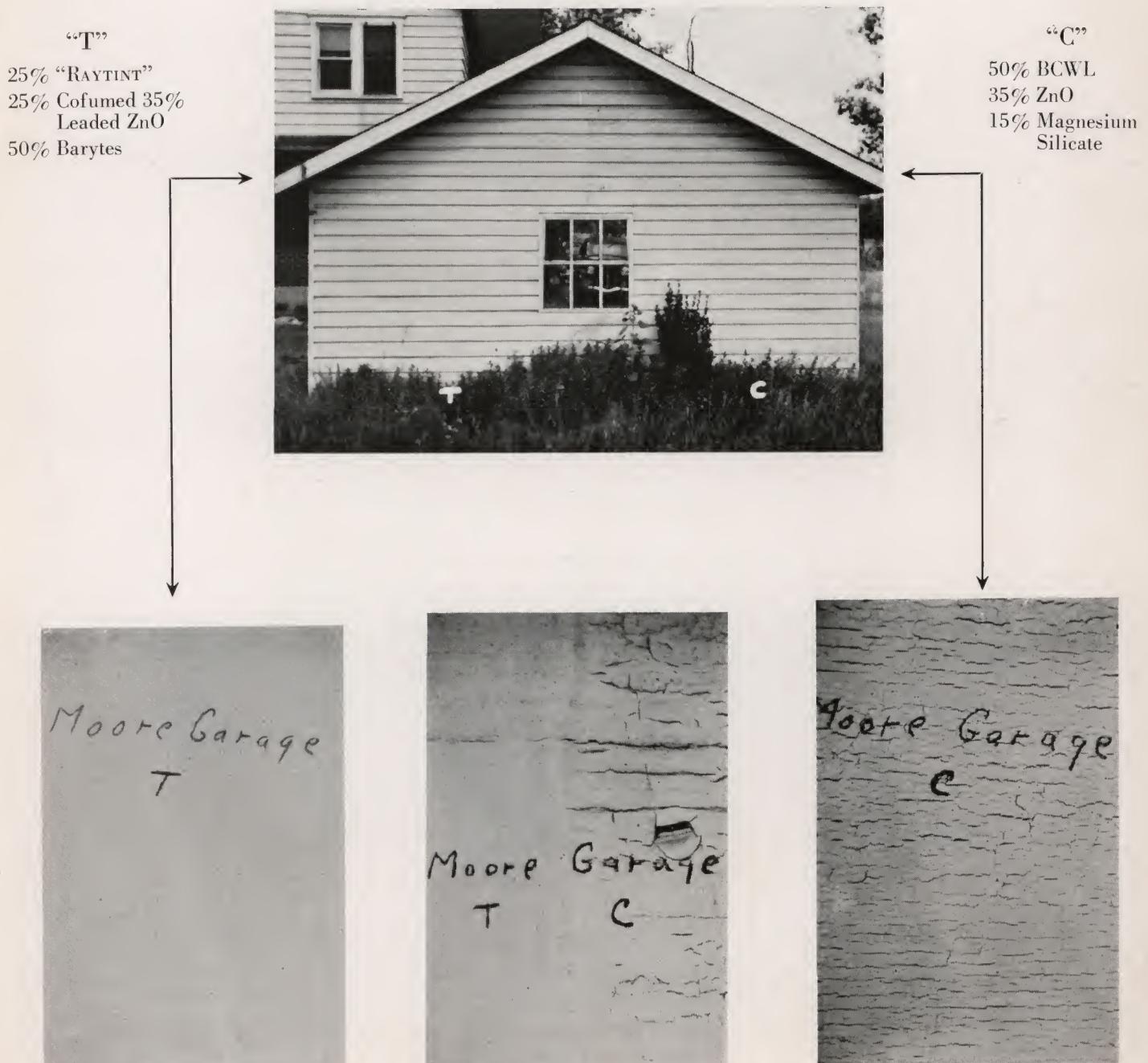


PLATE No. 13
Color of "RAYOX" O vs. "RAYSIL"
White Paints
Kaolin, Pennsylvania
13 months
South Vertical



37.3% "RAYSIL"
45.0% Cofumed 35%
Leaded ZnO
17.7% Magnesium
Silicate

TiO_2 in "RAYSIL"
replaced with "RAYOX" O

PLATE No. 14
Fading of "RAYOX" O vs. Lead in Oil
Buff Paints
Wilmington, Delaware
15 months
North Vertical

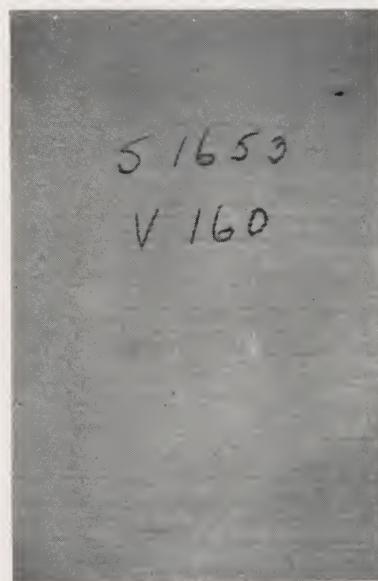


Lead in Oil
(spotty, faded)

12% "RAYOX" O
44% Cofumed 35% Leaded ZnO
44% Magnesium Silicate
(Uniform in appearance, tint intact)

PLATE No. 15
“RAYOX” O vs. Lead-Zinc-Inert
“RAYOX” O Paint Free of Cracking and Dirt

Delaware
26 months
South Vertical



50% BCWL
35% ZnO
15% Magnesium Silicate

12% “RAYOX” O
44% Cofumed 35% Leaded ZnO
44% Magnesium Silicate

Complete Formulas:

For Normal Hiding

	<i>1 Gallon</i>	<i>100 Gallons</i>
"RAYOX" O	1.01#	101#
Cofumed 35% Leaded Zinc Oxide	3.72	372
Magnesium Silicate	3.72	372
Alkali Refined Linseed Oil	4.48	57.8 gals.
Kettle Bodied Linseed Oil (Body "Q") .....	.39	4.9 "
Drier "P" (see below).....	.26	2.9 "
Mineral Spirits .....	.54	8.3 "
	14.12#	

For High Hiding

	<i>1 Gallon</i>	<i>100 Gallons</i>
"RAYOX" O	1.56#	156#
Cofumed 35% Leaded Zinc Oxide	3.65	365
Magnesium Silicate	3.34	334
Alkali Refined Linseed Oil	4.45	57.4 gals
Kettle Bodied Linseed Oil (Body "Q") .....	.39	4.9 "
Drier "P" (see below).....	.26	2.9 "
Mineral Spirits .....	.57	8.8 "
	14.22#	

The Importance of Drier Composition

Drier P: its purpose; its preparation.

Driers are important constituents of outside paints, since they affect both working properties and durability. The Drier "P" specified in the formulas shown herein is regarded as offering definite advantages, particularly in achieving a type of consistency which gives good brushing properties to the paint, and at the same time good durability. It produces a slight "false body" and a slightly thicker consistency than are normally produced by naphthenate driers. Drier "P" is a lead manganese linoleate type, carrying a ratio of 30 parts of lead to 1 part of manganese. It is generally used in sufficient quantity to give 0.6% lead and 0.02% manganese, calculated as metal, and based on the non-volatile vehicle in the paint. The finished drier has the following composition:

Lead	13.29%
Manganese	0.43%
Linseed Oil	64.04%
Mineral Spirits	22.24%
	100.00%

The making directions for Drier "P" are as follows:

Formula

Litharge	147.00#
Manganese Borate	22.00#
Alkali Refined Linseed Oil .....	.84 gals.
Mineral Spirits	35 gals.
Total Pounds	1051.77#
Estimated Loss	31.77#
Yield 115 gals.	1020.00#

Gallon weight: 8.84#-8.77#

Body required: V to X (Gardner-Holdt)

Procedure:—

Mix litharge and manganese borate thoroughly; dry. Stir this mixture into 6 to 9 gallons of alkali oil in a change-can mixer or its equivalent. Using a Monel metal, copper, or equivalent kettle (preferably not iron), heat the remainder of the oil (78 to 75 gallons) to 360°F. Add gradually the slurried chemicals with vigorous stirring as the temperature of the oil continues to rise being certain that the addition is completed in 15 minutes and before the temperature reaches 445°F. Hold at 445°F. for 30 minutes after all the metals are added. Cool to 300°F. and thin. In the above formula a loss of 31.77# is estimated. This may be high in some varnish plants. It is suggested, therefore, that the first addition of thinner be 30 gallons of mineral spirits and that further thinner be added, if needed, to control the drier within the viscosity and gallon weight figures specified.

Effect of Driers upon Durability and Properties of Paint

The following conclusions, based on test fence data, have been drawn in relation to drier composition and paint durability:

1. Litharge in exterior paints tends to induce checking and cracking failure and to retard erosion. See Plate #16.
2. Cobalt and litharge used together as driers in exterior paints tend to decrease durability. See Plate #17. There is also some evidence that cobalt increases fading.
3. Naphthenate type driers substituted for Drier "P" at equal metal content, yield essentially equal durability. The types are generally interchangeable, but the naphthenate driers usually impart less "false body" to paints and therefore require less thinner for proper brushing consistency than the linoleate type driers. As a result, paints containing the naphthenate driers have more pull under the brush, better leveling, and better gloss than paints containing the linoleate driers. These differences, however, are only slight. In some cases, particularly where the magnesium silicate content is high, a judicious balance between these two types of driers is advisable.

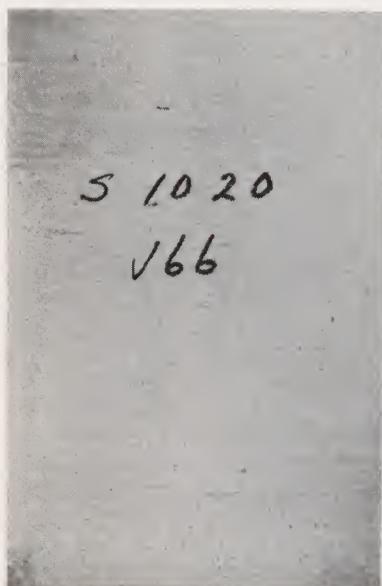
The Selection of Zinc Oxides

Zinc oxides are essential to the composition of good exterior house paints, since good durability and satisfactory appearance are desired. If zinc oxide is omitted, the paints resist mildew poorly, if at all, and collect dirt excessively. The result is poor general appearance. See Plates #18, #19, #20. If, however, sufficient pure zinc oxide is added to the zinc sulfide or the titanium type paints to prevent excessive chalking and erosion, premature checking and cracking may result. These difficulties can be surmounted by the use of *cofumed* leaded zinc oxide. It is possible to add this pigment in sufficient quantity to control chalking and erosion, without producing objectionable checking and cracking.

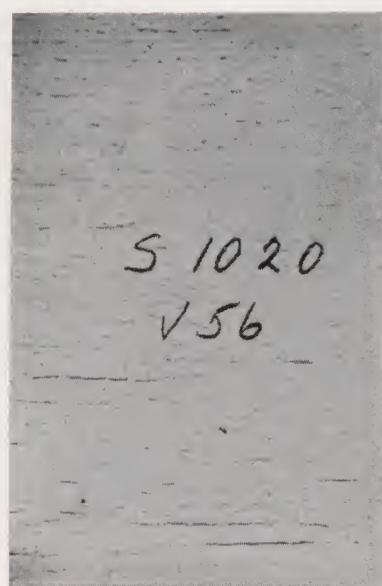
It is better, however, to use *cofumed* leaded zinc oxide rather than blends of pure zinc oxide and basic lead sulfate, since such blends show little advantage over pure zinc oxide. The advantages of *cofumed* leaded zinc oxide over mechanical mixtures of zinc oxide and white lead are indicated by Plates #21, and #22.

PLATE No. 16
Litharge Induces Cracking

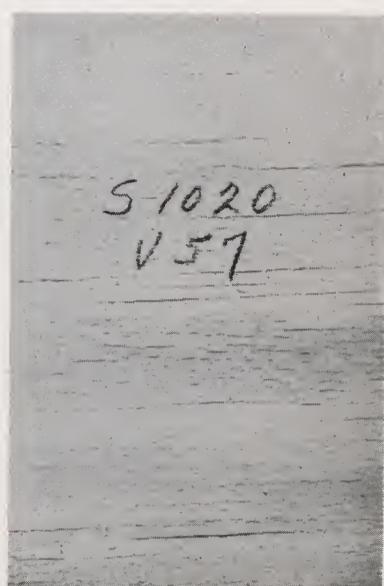
Delaware
42 months
South Vertical



40.0% Lithopone
45.0% Cofumed 35% Leaded ZnO
7.5% Magnesium Silicate
7.5% Silica



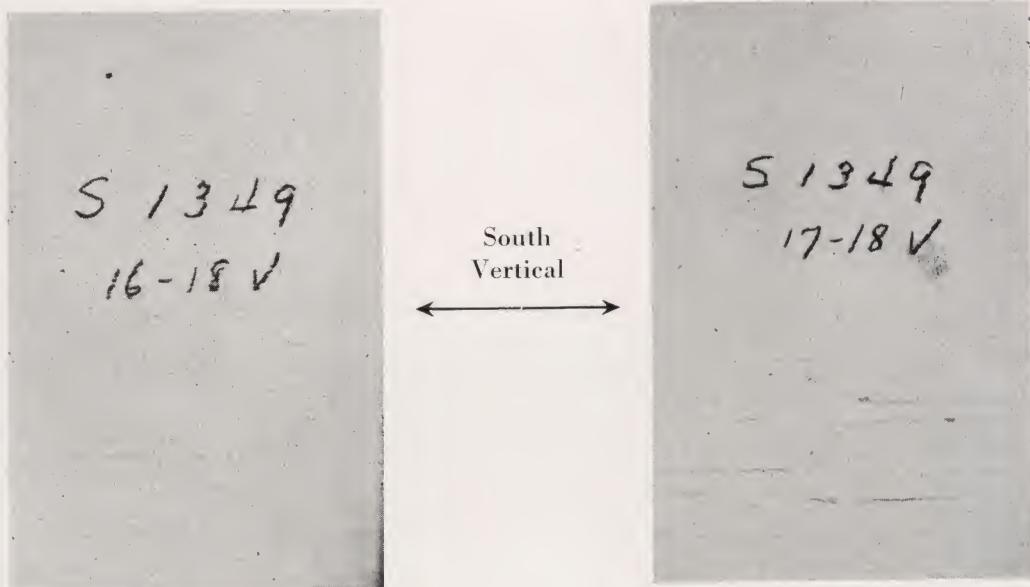
2.5% Litharge added to S1020-66
replacing an equal volume of
Leaded Zinc Oxide



5% Litharge added to S1020-66
replacing an equal volume of
Leaded Zinc Oxide

PLATE No. 17
Cobalt and Litharge Induce Cracking

Delaware
29 months



30% "RAYBAR"
30% BCWL
30% ZnO
10% Magnesium Silicate

1.5% Litharge and .055%
Co (based on the total oil
content) added to S1349-16-18

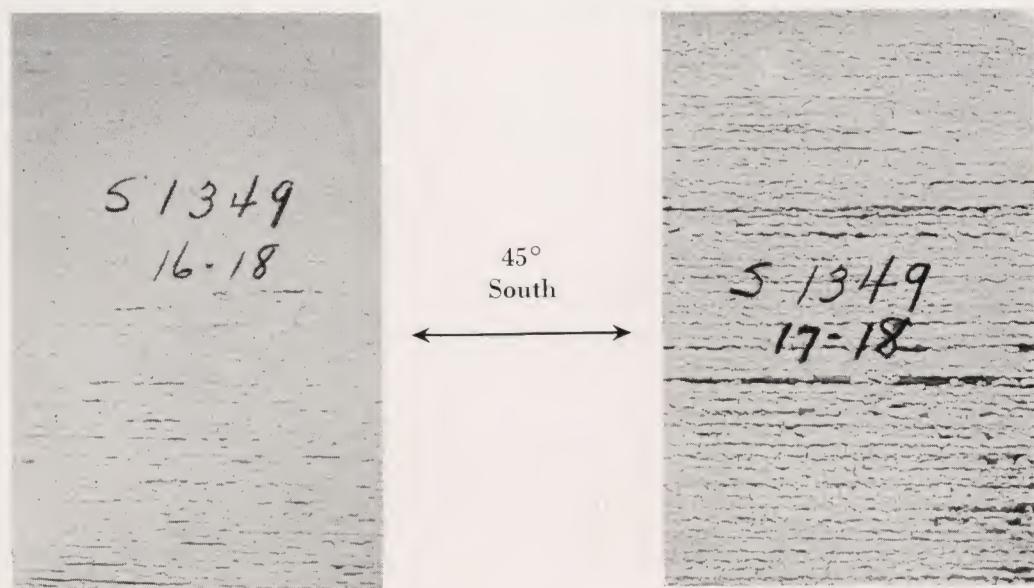


PLATE No. 18

Dirt Collection of a Zincless Pigmentation
in Various Fortified Vehicles

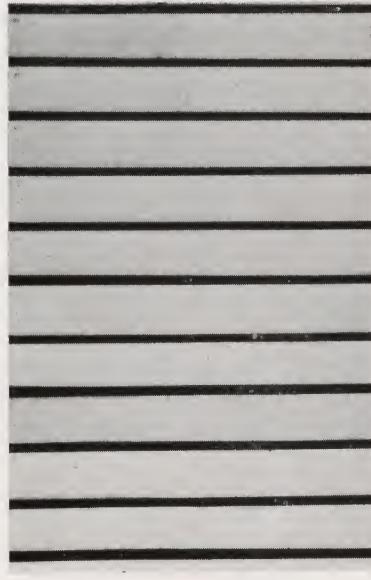
Wilmington, Delaware

16 months

South Vertical



40% Titanium Barium Pigment
40% BCWL
20% Magnesium Silicate



40% Titanium Barium Pigment
40% Cofumed 35% Leaded ZnO
20% Magnesium Silicate

PLATE No. 19

Dirt Collection of a Zincless Pigmentation
in Various Fortified Vehicles

Wilmington, Delaware

32 months

South Vertical



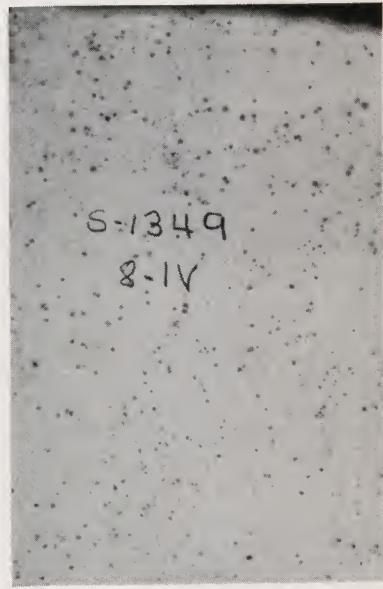
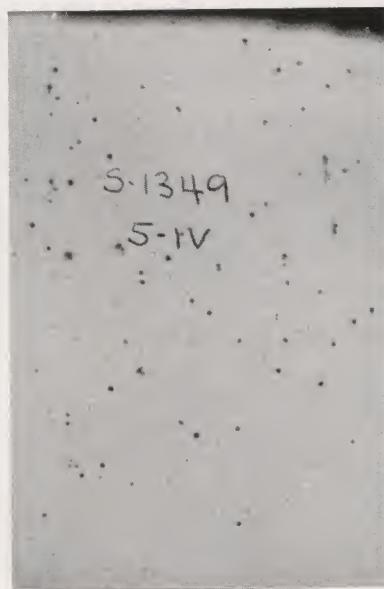
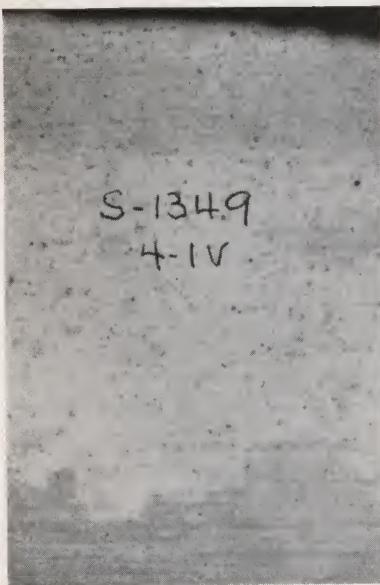
40% Titanium Barium Pigment
40% BCWL
20% Magnesium Silicate



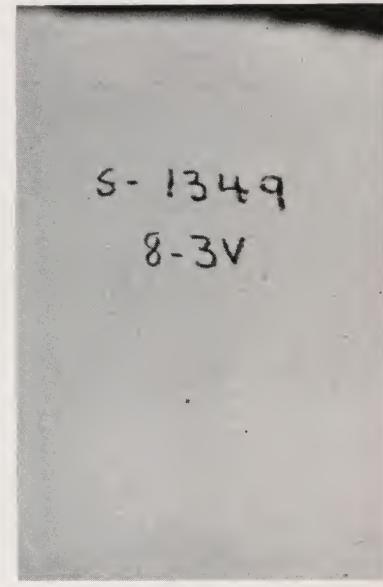
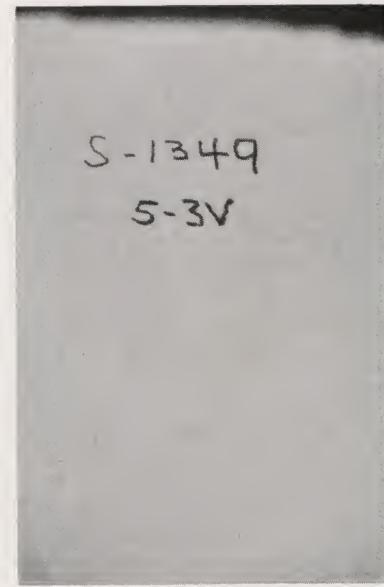
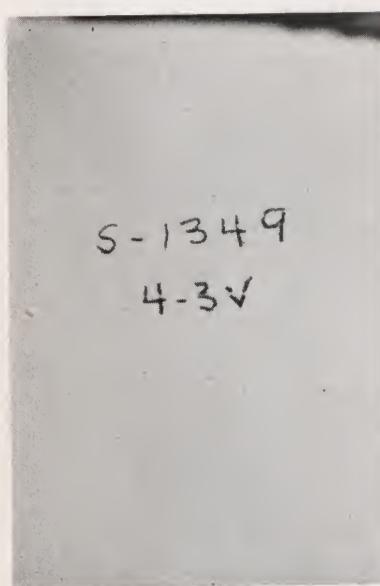
40% Titanium Barium Pigment
40% Cofumed 35% Leaded ZnO
20% Magnesium Silicate

PLATE No. 20
Mildew with Zincless Pigmentation
in Various Fortified Vehicles

Delaware
20 months
South Vertical

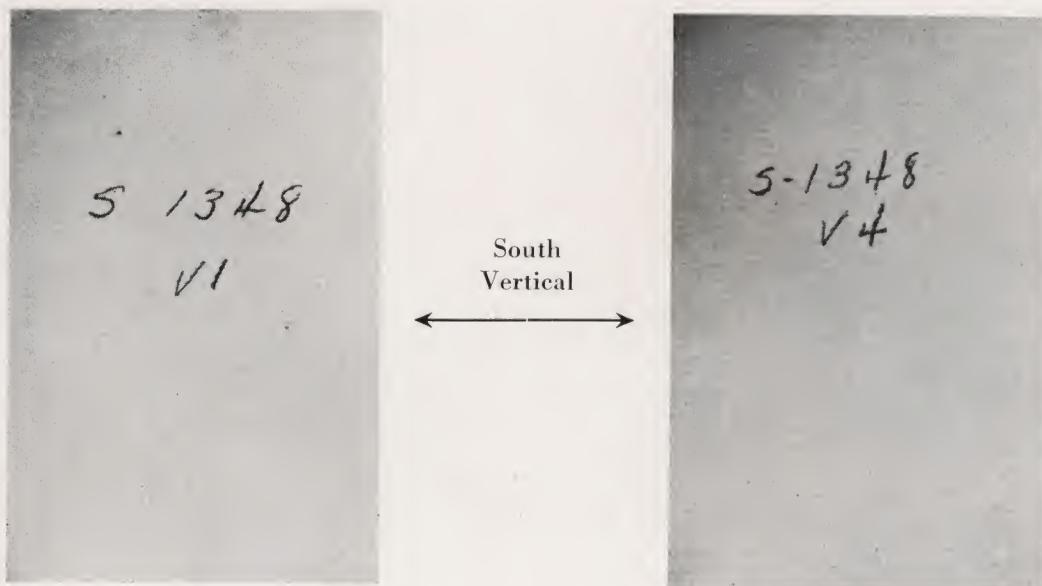


40% Titanium Barium Pigment
40% BCWL
20% Magnesium Silicate



37.3% "RAYSIL"
45.0% Cofumed Leaded ZnO
17.7% Magnesium Silicate

PLATE No. 21
Cofumed vs. Mechanically Blended Leaded ZnO
Delaware
22 months



40% "RAYBAR"
40% Cofumed 35% Leaded ZnO
20% Magnesium Silicate

Mechanically Blended 35% leaded
ZnO replacing the cofumed
product in S1348-1

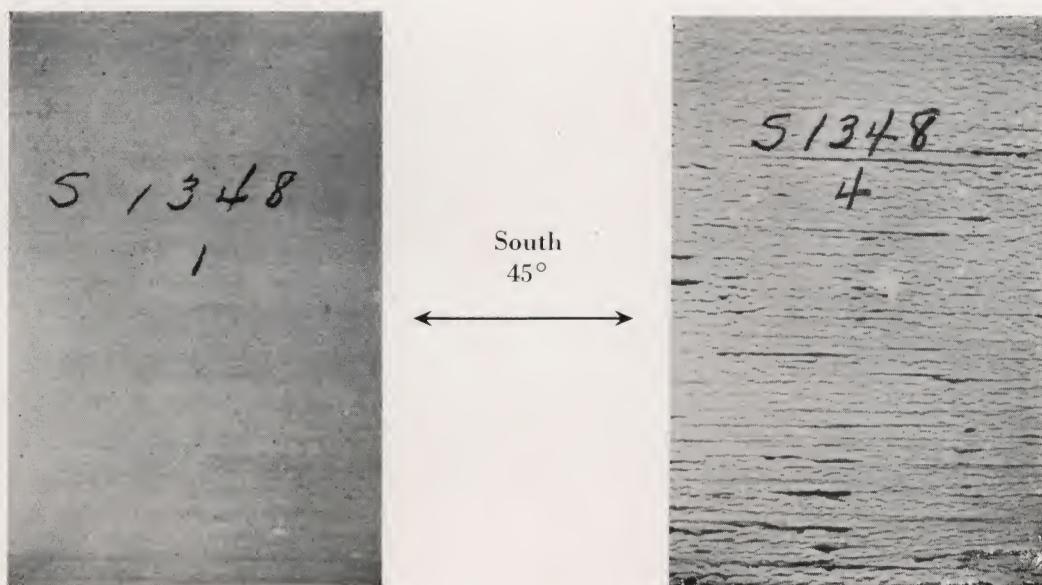
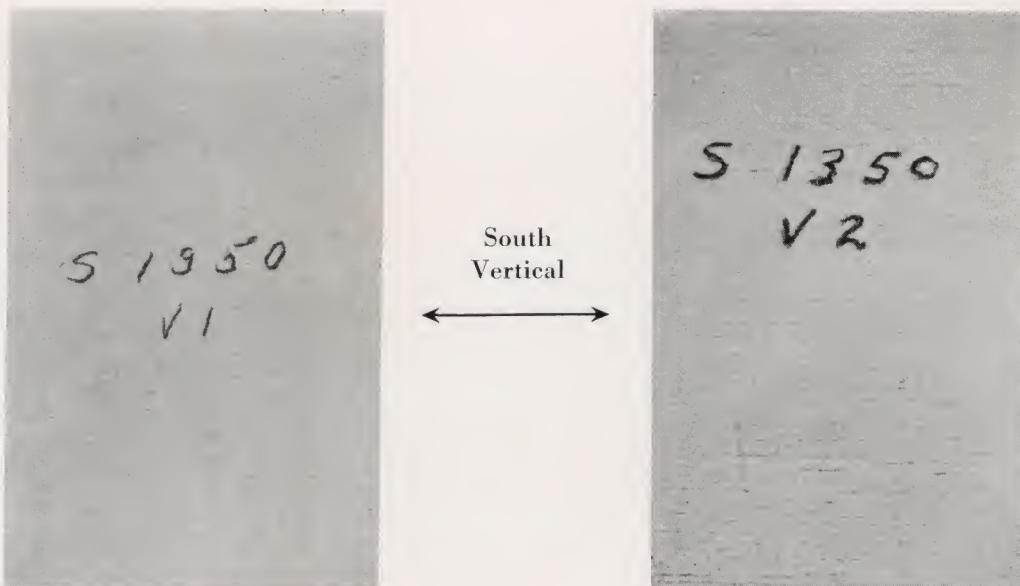
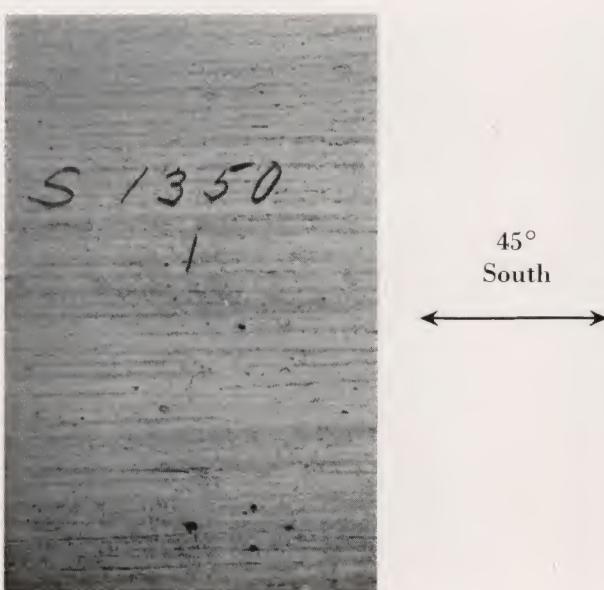


PLATE No. 22
Cofumed vs. Mechanically Blended Leaded ZnO
Delaware
32 months



Modified Formula K
45% Lithopone
40% Cofumed 35% Leaded ZnO
15% Magnesium Silicate

Modified Formula K
45% Lithopone
14% BSWL
26% ZnO
15% Magnesium Silicate



There are several new types of pure zinc oxide now available on the market, some of which are testing out well in house paint compositions, but since these pigments have been on exposure only three years, the present data are deemed insufficient to assess fully their value in exterior house paints.

The Selection of Extenders

Extenders or inert pigments no longer play the role of cheapening agents in house paints. Their contribution to durability is now recognized though they lose none of their economy through this new knowledge of their value. Earlier in this booklet it was shown that when inexpensive magnesium silicate was replaced by the more costly white lead a less durable paint resulted.

Not all extenders have such value, however. Many may still be classified merely as cheapening agents. The present state of knowledge on this matter is that certain silicates conduce to improve quality. The fibrous and flake-like structure of such minerals is a distinguishing mark. Mica, talc, magnesium silicate, diatomaceous silica are among the valuable inerts for this application. Such minerals as barytes, whiting, china clay, calcium sulphate and ground silica are inferior and in some cases are deleterious to house paints.

Plate #23, a record of South vertical exposures, shows the differences in durability available through choice of the extender. These differences are augmented in the 45° South record as shown on Plate #24.

Plate #25 is of considerable interest because it relates part of the story which unfolded as "RAYSIL" was being studied initially and it indicates the value of using a selected, evenly-sized, blended extender in composing a house paint formula.

Moisture Failure

Moisture failure of exterior house paints is a subject which deserves serious consideration until such time as satisfactory solutions are available for the difficulties commonly encountered. That it is no small problem is indicated by such excellent papers on the subject as:

Proceedings of American Chemical Society, Paint & Varnish Chemistry Division, Wednesday, April 4, 1939, Baltimore, Maryland. "MOISTURE FAILURE OF HOUSE PAINT. I—THE EFFECT OF CERTAIN STRUCTURAL DETAILS" by John W. Iliff and R. B. Davis.

Circular 355—August 1929, Scientific Section—Educational Bureau, American Paint & Varnish Manufacturers' Association. "CAUSES OF PAINT FAILURE ON SIDEWALLS" by Otto R. Hartwig.

Circular No. 567—September 1938, Scientific Section, National Paint, Varnish & Lacquer Association, Inc. "PAINT FAILURES IN OKLAHOMA CITY" by Leland P. Hart, George L. Ball, Jr., and Eric E. Johnson.

It seems beyond question that construction defects, as well as humidification and insulation without sufficient ventilation or supplementary means of protecting exterior

PLATE No. 23

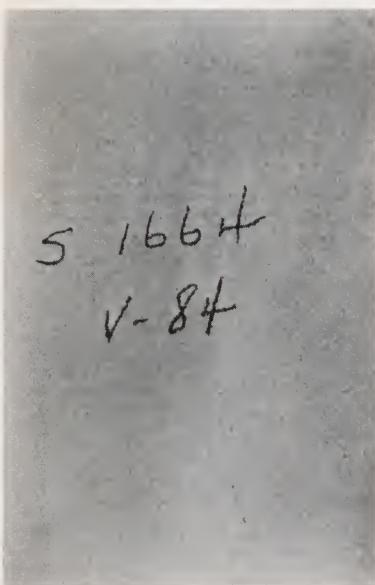
The Effect of Extenders upon Durability

Delaware
20 months
South Vertical

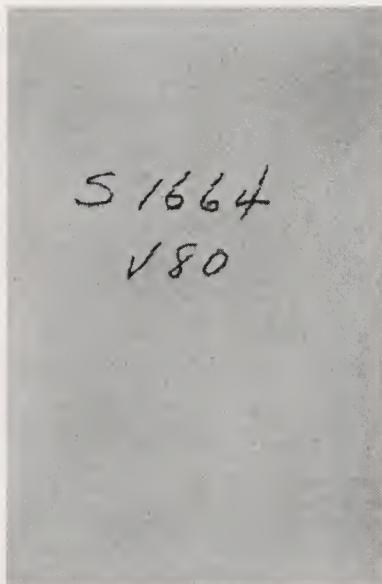
Modified Formula K

45% Lithopone
40% Colfumed Leaded ZnO
15% Magnesium Silicate

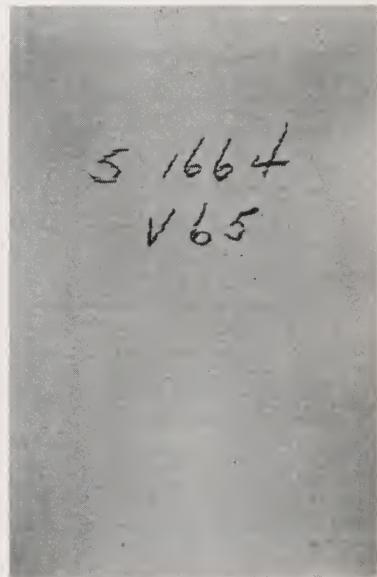
Extender replacements
made at equal volume



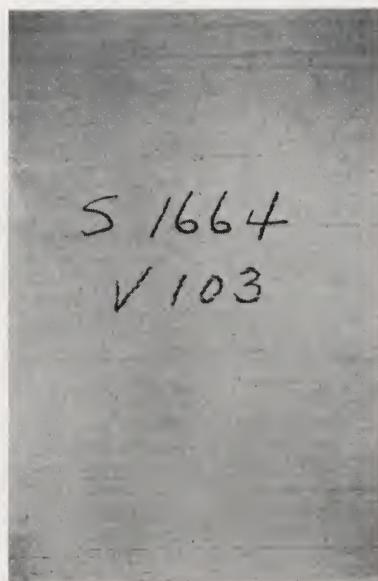
Mica



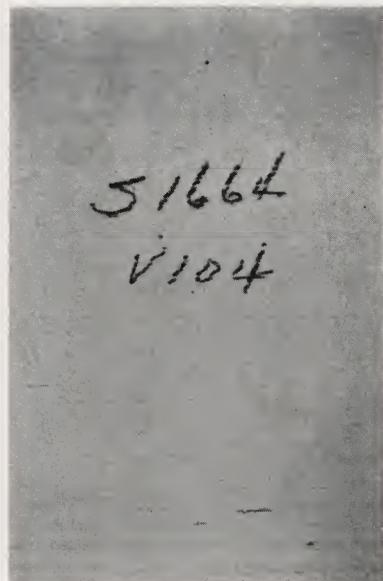
Talc



Magnesium Silicate



Barytes



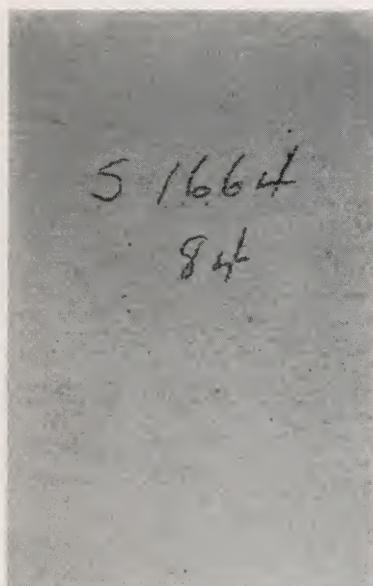
Silica

PLATE No. 24
The Effect of Extenders upon Durability

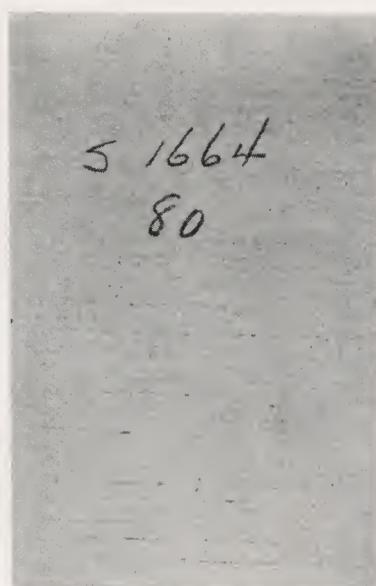
Delaware
20 months
45° South

Modified Formula K

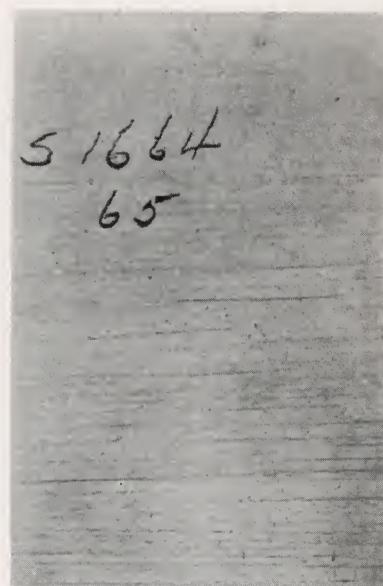
45% Lithopone
40% Cofumed 35% Lead ZnO
15% Magnesium Silicate
Extender replacements
made at equal volume



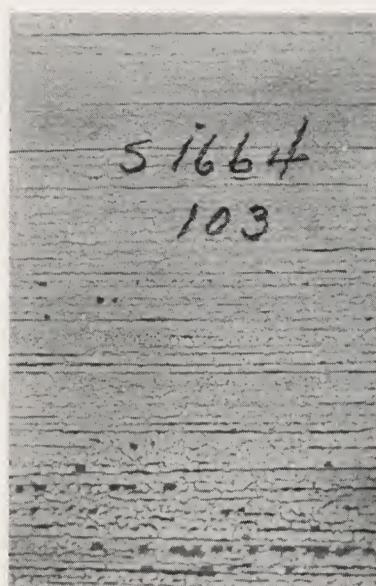
Mica



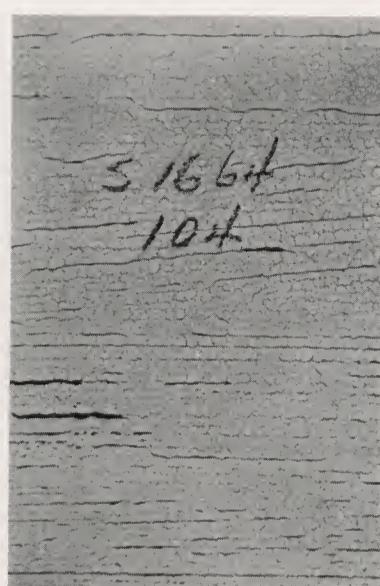
Talc



Magnesium Silicate



Barytes



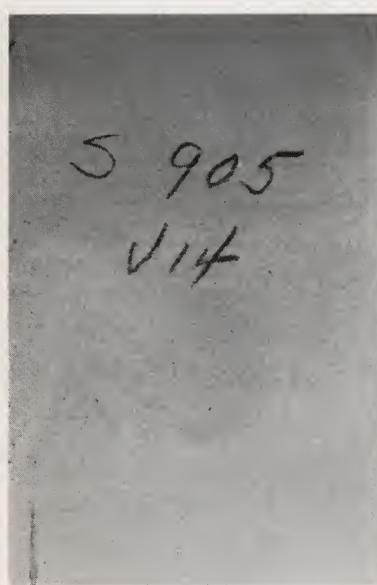
Silica

PLATE No. 25

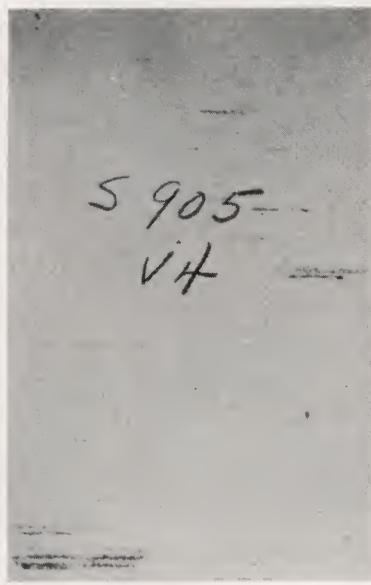
The Effect of Extenders upon Durability

Delaware
56 months
South Vertical

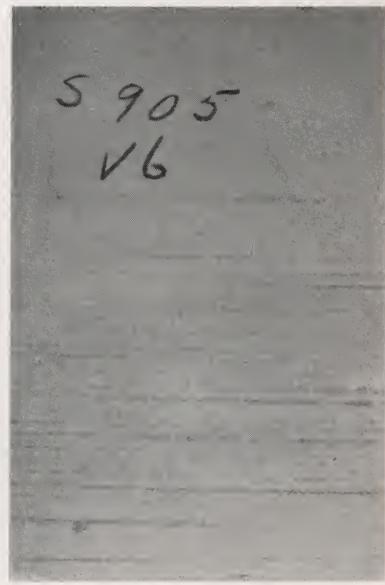
25% TiO₂
25% Cofumed 35% Leaded ZnO
50% Magnesium Silicate
Extender replacements
made at equal volume



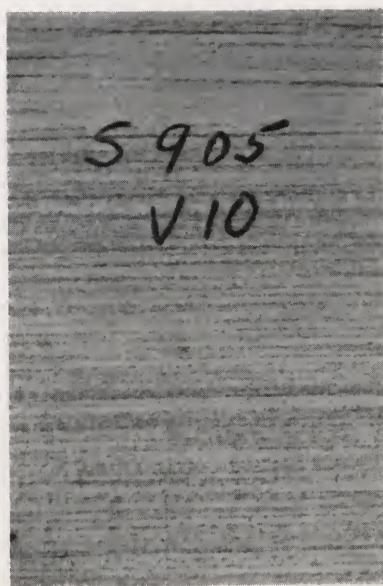
Mica



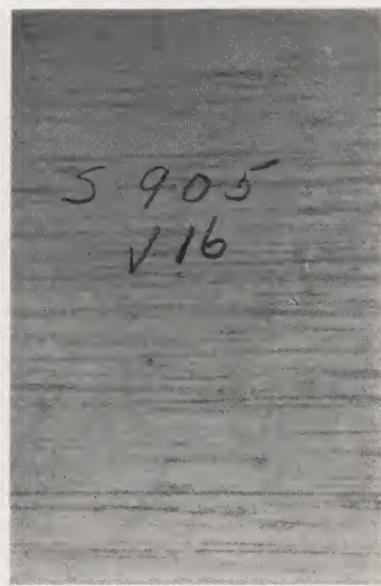
Talc



Magnesium Silicate



Barytes



Silica

walls from moisture, are extremely important factors in causing paint failures. It is generally admitted that no unbroken paint film will withstand moisture reaching it through the wood. It is granted that paint films differ in their ability to withstand moisture, and it is believed that real progress will be made in the development of paint films which will breathe sufficiently to transmit moisture reaching them, and also allow the entrapped air and water vapor to escape from the undersurface of the paint film.

There are also other factors affecting the durability of paint films, to which adequate answers will ultimately be obtained. Such factors are adhesion, penetration, film toughness, etc., but to date no completely satisfactory solutions are available. These problems are receiving active consideration, involving extensive exposure studies, under conditions of controlled temperature and humidity, in the hope that a solution of these problems will provide a definite contribution to the technology of paints and will be of material assistance to the paint manufacturing industry, by pointing out the way to decreased paint failures even under adverse conditions.

The formulations and results given above while based on our experience are not guaranteed.



R. T. VANDERBILT CO. LABORATORY, EAST NORWALK, CONN.

